

THE THEBES SANDSTONE AND ORCHARD CREEK SHALE AND THEIR FAUNAS IN ILLINOIS

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The Thebes sandstone was named by Worthen¹ in 1866 from the town of Thebes, in Alexander County, Illinois, near which the formation is well exposed. This sandstone is known in Illinois over only a relatively narrow area bordering Mississippi River in the southwest part of the State. West of this the strata extend into adjacent portions of Missouri, and outcrop in several places in the vicinity of Cape Girardeau. The total thickness of the formation in this region is about 75 feet.

The basal portion of the Thebes sandstone is exposed along a small stream in the south part of the town of Thebes, where it rests unconformably upon the Fernvale (early Richmond) limestone. This lower sandstone is here fine grained, yellowish brown, and micaceous, with a thickness of 6 or 8 feet, and grades upward into a coarser grained, bluish sandstone with few fossils.

The following species of fossils are common in the fine grained basal phase of the Thebes sandstone:

Climacograptus putillus Hall.

Lingula ovoidea n. sp.

Conularia ornata n. sp.

Isotelus brevicaudatus n. sp.

Endymionia bellatula, n. sp.

The lower horizon of the Thebes sandstones containing *Endymionia bellatula* is exposed again farther north in the south bank of Madison Creek, in the S. E. quarter section 8, T. 11, S. R. 2 W., in Calhoun County. The sandstone here is yellow to buff, and thin bedded. It rests unconformably upon the Kimmswick limestone, and passes upward into a bed of sandy shale.

Still farther north, in Pike county, Missouri, a sandstone that corresponds to the basal portion of the Thebes formation is exposed along a stream one-half mile west of Dover Church.

1. Worthen, A. H., Geol. Survey of Illinois, Vol. I, p. 139, 1866.

This sandstone is bluish gray, and also contains numerous more or less complete tests of *Endymionia bellatula*. This species of *Endymionia* is not known to occur at any other horizon and hence furnishes a reliable guide to the basal portion of the Thebes sandstone.

The middle part of the Thebes sandstone formation can be studied in good outcrops in the bank of Mississippi River a short distance north of the railroad bridge in the town of Thebes, and also in the bank of the river about three miles north of the latter place. Corresponding strata are also well exposed in the railroad cut a short distance east of Thebes, and along the Chicago and Eastern Illinois railroad within a distance of one mile both north and south of the village of Gale, in Alexander County. At the above mentioned localities the sandstone is bluish where unweathered, and is coarser grained and thicker bedded than the material in the basal part of the Thebes formation. The fossils *Climacograptus putillus* and *Lingula ovoides* are present throughout this formation.

The upper part of the Thebes sandstone outcrops in the east bank of Mississippi River, and in a cut along the Chicago and Eastern Illinois railroad one-half mile south of Gale, where the contact of this sandstone with the overlying Orchard Creek shale is well exposed. The material in the upper part of the Thebes formation is bluish, rather coarse grained, and occurs in layers 4 to 10 inches thick. The fossils are similar to those present in the middle part of the sandstone.

AGE OF THE THEBES SANDSTONE

Although the Thebes sandstone in this region contains none of the species of fossils characteristic of the normal Richmond or Maquoketa strata, the stratigraphic position of the formation lying above the Fernvale (early Richmond) limestone as it does at Thebes, Illinois, and Cape Girardeau, Missouri, and below the Orchard Creek (early Silurian) shale, as south of Gale, fixes its age as somewhere in the Richmond stage. It cannot be very early Richmond inasmuch as the Thebes sandstone not only overlies the Fernvale (early Richmond) limestone, but is separated from this limestone by a sedimentary break of considerable length. Judging from the numerous, widely separated areas in which the Fernvale lime-

stone is known, and where it is only a few feet in thickness, it seems probable that a period of general peneplanation in this region intervened between the deposition of the latest of the Fernvale limestone and the earliest of the Thebes sandstone. The latter formation could thus not be older than about middle Richmond, and possibly is late Richmond in age.

The unconformable relations of the Thebes sandstone with the underlying Fernvale limestone or older rocks in this region indicates that the remarkable succession of oscillatory movements of advance and retreat of the sea that occurred in the lower Mississippi embayment during the Alexandrian epoch of the Silurian period began here during the early part of Richmond time.

THE ORCHARD CREEK SHALE

The Orchard Creek shale occupies the distinguished position of being the oldest fossiliferous marine formation of Silurian age known in the United States. It is even more restricted in its distribution than the Thebes sandstone, being known in Illinois in only a few places in Alexander county in a distance of 4 or 5 miles north and south of Thebes. The formation was named from Orchard Creek which joins the river south of Thebes in Alexander county, near the mouth of which stream this shale is exposed in the bank of Mississippi River.

The best known exposures of shale of this formation is along the Chicago and Eastern Illinois railroad about one-half mile south of Gale, and in the river bank near this place. The strata consist of bands of blue or bluish-gray calcareous shale, 4 to 6 inches thick, alternating with layers of impure, argillaceous limestone which in the lower and middle parts are 2 to 4 inches thick. The calcareous layers become thicker and closer together in the upper part where the bed grades upward without any distinguishable sedimentary break into the overlying Girardeau limestone. The total known thickness of the formation is about 22 feet.

The calcareous layers of this formation furnished the following species of fossils:

Fossils from the Orchard Creek Shale:

Strophostylus ornatus n. sp.

Cyclocystoides ornatus n. sp.

Prasopora sp.

Chasmatopora granistriata (Ulrich).

Plectambonites aff. *sericeus* (Sowerby).

Rafinesquina near *alternata* (Emmons).

**Rafinesquina mesicosta* (Shumard).

**Leptaena rhomboidalis* (Wilckens).

Strophomena aff. *planumbona* (Hall.)

**Protozeuga sulcocarinata* Savage.

**Homoeospira immatura* Savage.

Dalmanella meeki (Miller).

**Dalmanella modesta* Savage.

**Rhynchotrema* (?) *illinoisensis* Savage.

Pterinea thebesensis Meek and Worthen.

Pterinea oblonga n. sp.

Cf. *Byssonychia tenuistriata* Ulrich.

Lyrodesma sp.

**Phragmolites imbricatus* (Meek and Worthen).

Strophostylus ornatus n. sp.

**Cornulites incurvus* (Shumard).

**Cornulites tenuistriatus* (Meek and Worthen).

Isotelus convexus n. sp.

**Acidaspis halli* Shumard.

**Calymene dubia* Savage.

**Cyphaspis girardeauensis* Shumard.

**Encrinurus deltoideus* Shumard.

Ceratopsis robusta, Ulrich.

In the foregoing list of fossils, those species that continue upward into the overlying Girardeau limestone are indicated by a star in front of the name.

In a former paper the Orchard Creek shale was recognized as closely allied to the Girardeau limestone, but on account of the presence in this fauna of certain species with strong Richmond aspect, the formation was provisionally referred to late Richmond time. More recent study of the fauna of the Girardeau limestone¹ and of the Orchard Creek shale, has convinced the writer that the affinities of the Orchard Creek shale fauna are much closer with the Girardeau limestone fauna than with that of any Richmond. The large proportion of species occurring in both formations may be seen in the above list of fossils. The significance of the similarity of the fauna of the Orchard Creek shale to that of the Girardeau limestone is also much more important than the persistence of a few Richmond species in the Orchard Creek beds. Hence the Orchard Creek shale is now considered as representing the initial deposits in the early Silurian sea that advanced northward in this area from the Gulf of Mexico region.

DESCRIPTION OF NEW SPECIES OF FOSSILS FROM THE THEBES
SANDSTONE AND ORCHARD CREEK SHALE IN ILLINOIS

ECHINODERMATA

CYSTOIDEA

Cyclocystoides ornatus n. sp.

Plate II, Fig. 1.

Description: In some respects this species resembles *Cyclocystoides illinoisensis* described by Miller and Gurley from the Girardeau limestone, but it may be distinguished from that species in having only 20 plates in the submarginal ring (Miller and Gurley assume that *C. illinoisensis* would have from 24 to 30 plates), and the upper and outer side of each of these plates is marked by 4 transverse grooves while in *C. illinoisensis* there is no indication of such markings.

In the species here described the submarginal ring is sub-circular to subovate in outline, two specimens measured 22 mm. in the greater diameter and 19 mm. in the smaller, while a

q 1. Savage, T. E., Ill. State Geol. Surv. Bull. No. 23.

smaller individual was 16 mm. in larger diameter and 14 in the smaller. In the 4 good specimens at hand the submarginal ring is made up of 20 plates which are nearly equal in size, and much longer than wide. The upper and outer surface of the more elevated portion of each of these plates is grooved by 4 main transverse furrows which divide this part of the surface of each plate into 5 subequal transverse ridges. Besides these stronger transverse ridges and furrows, the surface of the plates is granulose when unworn. The spoon shaped excavations in the outer part of the submarginal plates, described by Raymond, are not well exposed, being covered by a series of small curved plates lying outside the more elevated portion of the submarginal plates of which in some places more than two are contiguous to a single one of the latter.

The disk within the submarginal ring is covered with small, convex, granulose plates of irregular shape, except in one place where the disk may be broken. In one of the specimens a narrow ridge extends from between adjacent submarginal plates for a short distance towards the center, but these are not thought to belong to the normal structure of the disk.

This species is rather common in the Orchard Creek shale, both north and south of Thebes, Illinois.

MOLLUSCOIDEA

BRACHIOPODA

Lingula ovoides n. sp.

Plate I, Fig 9.

Description: Shell subovate in outline; the lateral margins gently convex in the central portion, antero-lateral margins regularly convex, anterior margin broadly rounded, postero-lateral margins nearly straight, diverging at an angle of about 78 degrees.

Ventral valve moderately convex, the greatest convexity in a transverse direction, highest posterior to the middle from which the surface slopes rather regularly to the margins, but is less convex over the anterior portion; beak rather gradually tapering to the subacute apex. Surface marked by rather broad, low, concentric lines of growth which in places appear slightly lamellose.

Dorsal valve about equal in convexity to the ventral, the posterior margin more obtuse and the posterior lateral margins more convex than those of the ventral valve; a rather prominent internal median ridge is indicated by a depression in the surface of the impression of the interior extending from near the apex anteriorly to near the mid-length of the valve. Surface marked by concentric lines similar in character to those on the ventral valve.

The dimensions of the type specimen are: length 14 mm., width 8 mm., thickness about 2 mm. Shells of this species are sparingly present throughout the Thebes sandstone in Illinois.

In size and general appearance this species resembles *Lingula covingtonensis* from the Trenton limestone, but may be distinguished from that form by the less acuminate posterior portion, the narrower width of the shell in proportion to its length, and the more flattened character of the concentric ridges.

Hebertella lineolata n. sp

Plate I, Figs. 1 and 2.

Description: Shell subquadrate in outline, wider than long, the hinge line equaling, or a little shorter than the greatest width, the cardinal extremities obtusely angular to subrectangular.

Ventral valve moderately convex, the greatest depth near the middle on each side of the sinus, the surface sloping rather steeply from the beak and borders of the sinus to the front and lateral margins, but becoming gently convex towards the cardinal extremities; beak moderately prominent, arched; cardinal area of moderate width, gently concave, mesial sinus beginning in the umbonal region, and becoming wider and deeper to the front where it is somewhat produced, the bottom of the sinus flat or gently concave.

Dorsal valve strongly convex, the greatest depth in front of the umbonal region, the medial portion elevated into a flattened mesial fold which begins near the beak and becomes broader and increasingly prominent to the front where the valve is emarginate; bordering each side of the fold in the anterior portion of the shell the surface is flattened or slightly

concave from which depression the curvature is rather steep to the lateral margins and from the umbonal region to the cardinal area, the slope is less abrupt over the cardino-lateral margins, beak moderately prominent, strongly incurved.

The surface of both valves on each side of the fold and sinus is marked by 5 to 7 low, bifurcating plications which are progressively weaker toward the cardinal extremities; the bottom and sides of the mesial sinus are occupied by 3 to 5 similar plications, and a prominent furrow extends along the medial portion of the fold. Besides these stronger radiating markings, the surface of the plications and intervening depressions over the entire valves is ornamented by fine radiating lines; a few concentric lines of growth are often prominent near the anterior and lateral margins of the valves. The dimensions of the type specimens are: length 32 mm., width 39 mm., thickness 18 mm.

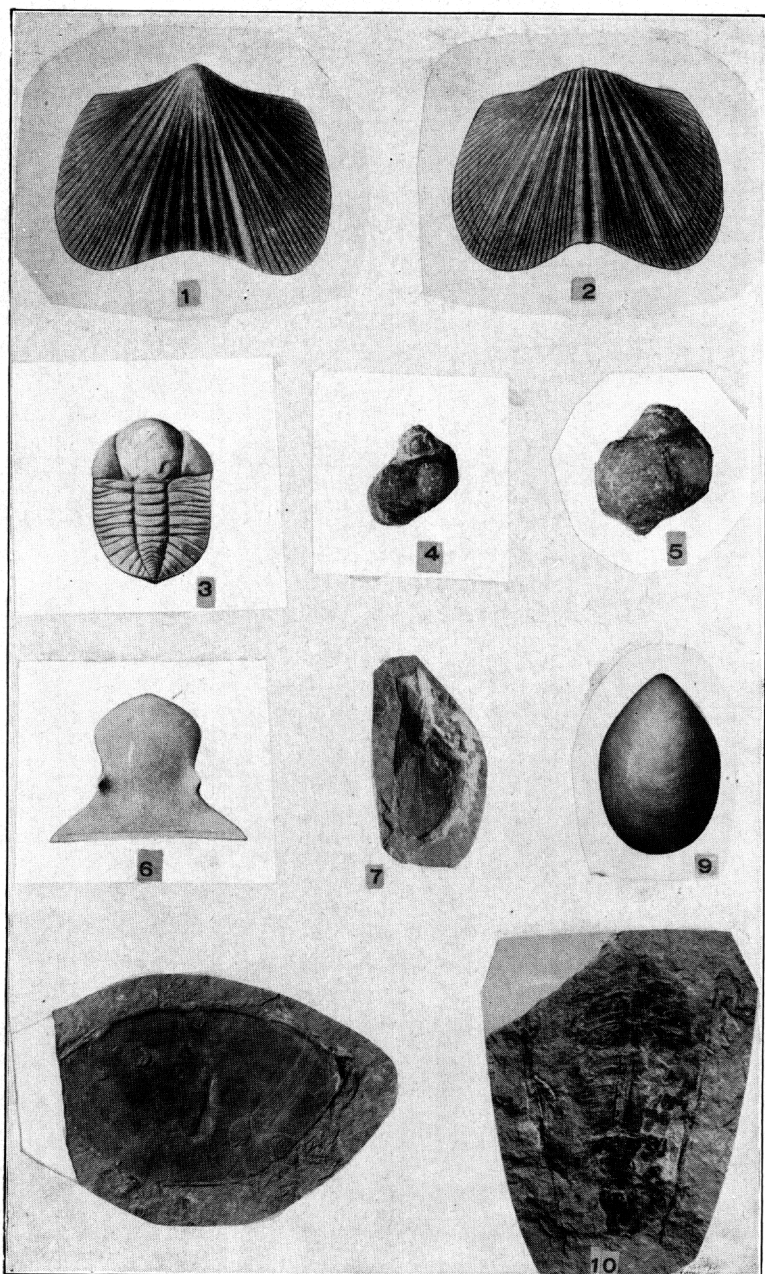
This species may be easily distinguished by its large size, the well defined fold and sinus extending nearly to the beaks, and the fine radiating striae that cover the coarser radiating markings. Shells of this species occur in the Fernvale limestone near Thebes, Illinois, and at Cape Girardeau, Missouri.

PELECYPODA

Pterinea oblonga n. sp.

Plate II, Fig. 2.

Description: In size and general outline this species more nearly resembles *Pterinea demissa* Conrad of the Richmond and Mayville beds than any other known species of the genus. It differs from Conrad's species in the longer and less obtuse anterior auriculation, and in the much shorter and less acute extension at the posterior extremity of the hinge line. Our shell is semielliptical in outline, exclusive of the auriculations; the right valve is oblique, longer than high, the greatest length along the hinge line, moderately convex over the umbonal region, antero-lateral and postero-lateral regions flat or nearly so, ventral half of the valve flat or slightly concave. Beak situated about one-fourth of the length of the cardinal margin from the anterior extremity. The anterior auriculation is slightly larger than the posterior one, depressed or flat, not



sharply defined from the body of the shell, the anterior margin meets the hinge line at an angle of about 50 degrees; is slightly sinuate below the auriculation below which it curves with gentle convexity to the broadly rounded ventral margin; posterior auriculation nearly flat, not sharply defined, the posterior margin forming an angle of about 45 degrees with the hinge line, below the auriculation the posterior border is nearly straight to near the lower part, where it blends with a broad curve into the ventral margin. Entire surface marked by numerous rather fine concentric lines of growth which are most conspicuous over the auriculations. A few indistinct radiating lines may also be present.

The dimensions of the type are: length along the hinge line 45 mm., greatest length below the auriculations, 37.5 mm., height 37.5 mm., convexity of right valve, 3 mm.

Shells of this species are rather rare in the Orchard Creek shale south of Thebes, Illinois.

GASTROPODA

Strophostylus ornatus n. sp.

Plate I, Figs. 4 and 5

1913 cf. *Cyclomema cancellata* Hall, Ill., State Geol. Survey, Extract Bulletin No. 23, p. 55, pl. 4, fig. 4.

Description: Shells resembling those of *S. cancellatus* Hall, to which species they were referred in a former report. However, the species here described may be distinguished from *S. cancellatus* by the more shallow suture, and the marked difference in surface ornamentation; in our species the revolving lines are much more numerous, and continue in full strength up to the suture, and into the umbilicus. The shell is turbate, height and width about equal, volutions about 4; apex small, upper volutions increasing rather rapidly in size to the body whorl which enlarges more rapidly forming from two-thirds to three-fourths of the height of the shell; the whorls are subovate in cross section, umbilicus shallow, inner lip slightly reflexed, outer lip not expanded, sutures not deeply impressed.

The height of different shells varies from 19 to 22 mm. and the width from 16.5 to 22 mm. The entire surface is orna-

mented with elevated revolving lines which are alternating in size, a weaker line occurring between two adjacent stronger ones. About ten of these lines occur in a space of 2 mm. The revolving lines do not become weaker near the suture, nor do they become obsolescent in the umbilicus; the raised lines are separated by depressed interspaces about equal in width to the lines. Numerous fine transverse lines and occasional coarser lines of growth cross the revolving ridges and furrows in a direction obliquely backward from the suture, and give to the surface a finely cancellated appearance.

Shells of this species are common in the Orchard Creek shale both north and south of Thebes. They occur also, though less abundantly, in the overlying Girardeau limestone in the same region.

CONULARIDA

Conularia delicatula, n. sp.

Plate I, Fig. 10

Description: Shell moderately large, pyramidal in form, quadrangular in transverse section, the sides gradually diverging from the apex to the aperture. The sides of the shell seem to have been somewhat convex and the angles apparently furrowed. The surface on each side is marked by a series of fine, close, transverse lines of which there are about 20 in a distance of 1 mm. These are directed slightly upward toward the aperture as they approach the angles.

Besides the numerous fine transverse raised lines and furrows, and occasional stronger transverse ridges or wrinkles, the fine transverse furrows are set at close intervals by minute tubercles or interruptions in the depressions, which under a lens are in places seen to be arranged in vertical rows in such a way as to resemble very fine longitudinal striae, and give to the entire surface an extremely delicately ornamented appearance.

This species occurs sparingly in the lower part of the Thebes sandstone in the vicinity of Thebes, Illinois. It is readily distinguished from other late Ordovician species of this genus by the very delicate character of its surface ornamentation.

ARTHROPODA

TRILOBITA

Isotelus brevicaudatus n. sp.

Plate I, Fig. 6, 7 and 8

Description: Cephalon transversely semi-elliptical in outline, length along the median line about 22 mm. which is a little less than half the width, genal angles rounded; occipital groove well defined. Glabella not distinctly defined, moderately convex in the median portion, slightly angular at its anterior extremity, width between the eyes slightly more than 12.5 mm., or a little more than half the greatest length of cephalon; eyes situated at or slightly posterior to the mid length of the glabella. Greatest width of glabella anterior to the eyes 23.5 mm. The facial sutures anterior to the eyes curve outward rather strongly to near the margin whence they continue around the anterior portion of the cephalon. Posterior to the eyes the facial sutures are directed backward and outward, cutting the posterior border of the cephalon more than half the distance between the points directly behind the inner margins of the eyes and the genal angles. Free cheeks about 9 mm. broad at the widest part, nearly twice as long as wide, the widest part opposite the posterior border of the eyes, the outer margin gently curved or nearly straight, and the genal angles rounded. Thorax not known.

Pygidium transversely subelliptical, a little longer than the cephalon, length 26.5 mm., width a little less than twice the length, ratio of length to width as 7 to 11; axis poorly defined, not extending to the posterior extremity, no segments visible on the axis or on the pleura, anterior border convex, antero-lateral margin rounded, posterior border broadly rounded. Marginal border slightly exfoliated, 6 mm. wide, and marked by fine lines sub-parallel with the lateral margins.

Fragments of the test of this species are very numerous in a narrow zone in the basal part of the Thebes sandstone where they are associated with *Endymionia bellatula*.

The species above described somewhat resembles *Isotelus susae* Whitefield in general outline of cephalon and pygidium, but differs from that form in the much greater constriction of

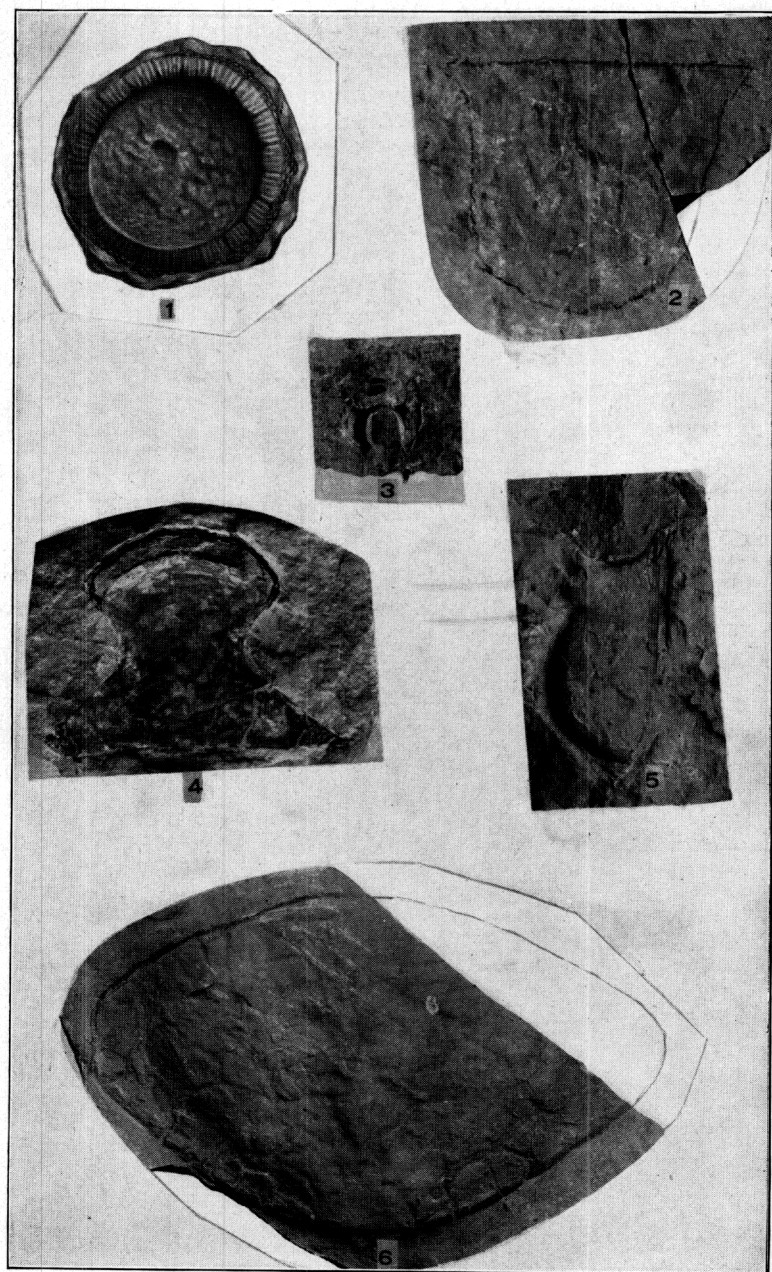
the glabella between the eyes which are situated much farther anteriorly than in Whitfield's species. These characters give to the cephalon of the two species quite a different appearance. From *Isotelus longaevus* of the Edgewood formation this species is distinguished by its much larger size, by the greater length of cephalon in proportion to the width, and by the narrower and relatively smaller free cheeks.

Isotelus convexa n. sp.

Plate II, Figs. 3, 4, 5 and 6

Description: This species is closely allied to *Isotelus brevicaudatus*, described on a former page from the Thebes sandstone in Illinois. It differs from that form in having the lateral margins of the expansion of the glabella anterior to the eyes more angular; in the shorter, more elevated and more rounded palpebral lobes, and in the relatively greater width and convexity of the free cheeks, and in the greater convexity of the cephalon and pygidium.

The cephalon is smooth, semi-elliptical in transverse direction, gently convex, about 31 mm. long on the median line, which is about one-half the width. The eyes are situated more than one-third of the distance to the front from the posterior border; genal angles rounded. Glabella not defined by distinct axial furrows, moderately convex in the median portion and anterior to the eyes; width at the constriction between the eyes 18 mm. which is slightly less than one-half the length of the glabella, and three-fifths of its greatest width in front of the eyes. The facial sutures anterior to the eyes curve rather abruptly outward to near the margin of the cephalon whence they continue forward near the anterior margin. Posterior to the eyes the sutures trend obliquely backward and outward to the posterior border of the cephalon which they reach about 26 mm. from the median line. Free cheeks large, rather convex, about 15 mm. wide and 30 mm. long, behind the posterior margin of the eye; genal angles rounded, without spines; palpebral lobe subcircular, elevated, and prominent. Hypostome short, narrowest in front of the branches, with relatively short lobes. Thorax not seen.



Pygidium transversely sub-elliptical in outline, moderately convex, length 52 mm, width slightly less than twice the length, without apparent concave border, although when only partially exfoliated undulating lines sub-parallel with margin are present near the border. Axial lobe poorly defined, much the widest anteriorly, the posterior end usually more prominent than the other portions, without annulations. Fragments of the test this species are common in the Orchard Creek shale north of Thebes, Illinois.

Endymionia bellatula n. sp.

Plate I, Fig. 3.

Description: The species here described is so unlike any other known trilobite that a comparison with other forms is unnecessary. The genus was described by Billings to receive the only species previously known in North America (*Endymionia meeki* Billings), which was found in rocks of early Ordovician (Canadian) age in eastern Quebec.

In the species here described the entire test is sub-elliptical in outline, the ratio of length and width as 7 to 5; lateral margins nearly straight, anterior and posterior borders rounded.

Cranidium transversely semi-elliptical to broadly sub-triangular in outline, length slightly more than one-third the entire length of the test, anterior portion broadly rounded, Glabella convex, nearly as wide as long, reaching the anterior margin, widest in the anterior portion, bordered laterally by well defined dorsal furrows, without lateral furrows, occipital furrow not prominent. The greatest width of the glabella is equal to or slightly greater than one-half the width of the cephalon. Outside the dorsal furrows the cheeks are sub-triangular in outline, smooth, gently convex, the outer margin gently rounded, and genal angles rounded, without spines. The position of the eyes and of the facial suture cannot be distinguished.

Thorax a little shorter than the cephalon, less than half as long as wide, composed of 5 segments; axial lobe defined by distinct dorsal furrows, slightly narrower than the pleural lobes, the extremities of the segments truncated bluntly, pleural portions of the segments marked on the dorsal surface by an undulating furrow.

Pygidium depressed convex, broadly triangular in outline, with entire margin, length a little less than that of the thorax, antero-lateral portions sub-angular, lateral and posterior margins rounded. The axis but slightly more elevated than the lateral lobes, a little less than one-third the width of the pygidium anteriorly, narrowing gradually to the posterior extremity. Segments of axis 7 to 9, well defined except in the posterior portion, lateral lobes with 7 visible segments which arch backwards and reach the margin, without furrows, the proximal portion of the anterior segment concealed by the posterior thoracic segment. The surface of the test without visible tubercles or other ornamentation.

The length of an average specimen is 11.5 mm., width 8 mm., length of cephalon 5 mm., length of thorax 3.5 mm., length of pygidium 3 mm. Fragments of the test of this species are numerous in the fine grained sandstone near the base of the Thebes formation, near Thebes, where it is associated with *Isotelus brevicaudatus*. It also occurs along Madison Creek in Calhoun County, Illinois and near Dover Church, in Pike County, Missouri.

EXPLANATION OF PLATE I.

Hebertella lineolata n. sp.

Fig. 1. View of ventral valve of type specimen.

Fig. 2. View of dorsal valve.

Natural size, Fernvale limestone.

Endymionia bellatula n. sp.

Fig. 3. Dorsal view of nearly complete test of type specimen. X 2. Thebes sandstone.

Strophostylus ornatus n. sp.

Fig. 4. View of nearly perfect specimen.

Fig. 5. Lateral view of a larger shell.

Natural size, Orchard Creek shale.

Isotelus convexa n. sp.

Fig. 6. Dorsal view of cranidium of type specimen lacking the free cheeks.

Fig. 7. A single free cheek of small individual.

Fig. 8. Dorsal view of pygidium of about average size. Natural size, Thebes sandstone.

Lingula ovoidea n. sp.

Fig. 9. View of ventral valve of type specimen. X2, Thebes sandstone

Conularia ornata n. sp.

Fig. 10. Lateral view of an incomplete specimen, natural size, Thebes sandstone.

EXPLANATION OF PLATE II.

Cyclocystoides ornatus n. sp.

Fig. 1. View showing ring of submarginal plates of type specimen, X 1 $\frac{1}{2}$. Orchard Creek Shale.

Pterinea oblonga n. sp.

Fig. 2. View of right valve of type specimen, natural size, Orchard Creek shale.

Isotelus convexa n. sp.

Fig. 4. View of cranium lacking free cheeks.

Fig. 5. Free cheek of a large individual.

Fig. 6. Dorsal view of pygidium.

Fig. 3. Hypostome thought to belong to this species. Natural size, Orchard Creek shale.
